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IS 9921-1 (1981): Alternating Current Disconnectors (Isolators) and Earthing Switches for Voltages Above 1 000 V, Part I: General and Definitions [ETD 8: High Voltage Switchgear and Controlgear]



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IS : 9921 (Part I) - 1981

(Reaffirmed 2002)

Indian Standard

SPECIFICATION FOR ALTERNATING CURRENT DISCONNECTORS (ISOLATORS) AND EARTHING SWITCHES FOR VOLTAGES ABOVE 1 000 V

PART I GENERAL AND DEFINITIONS

(Second Reprint SEPTEMBER 1993)

UDC 621.316.545+621.316.545.3

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

Indian Standard

**SPECIFICATION FOR
ALTERNATING CURRENT DISCONNECTORS
(ISOLATORS) AND EARTHING SWITCHES
FOR VOLTAGES ABOVE 1 000 V**

PART I GENERAL AND DEFINITIONS

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SPECIFICATION FOR ALTERNATING CURRENT DISCONNECTORS (ISOLATORS) AND EARTHING SWITCHES FOR VOLTAGES ABOVE 1 000 V

PART I GENERAL AND DEFINITIONS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 24 August 1981, after the draft finalized by the High Voltage Switchgear and Controlgear Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 With the large scale manufacture of air-break disconnectors in India, the need for specifying uniform requirements of such equipment was felt, particularly in view of different practices being followed by the manufacturers because of their tie-ups with different overseas manufacturers. This standard was, therefore, originally prepared as IS: 1818-1972* to meet this need and to provide guidance to the new manufacturers in this field.

0.3 The first revision of IS : 1818 was done in 1972, mainly for the purpose of taking into account the developments at the international level, and expanding the scope to cover ratings up to 420 kV. The revision, in comparison with the original version, also covered oil-break type isolators and earthing switches; the latter is considered similar in operation to the former. In making the revision however, it was recognized that when both the isolators and earthing switches are combined in one unit, an interlock is needed to be provided to ensure proper operation and safety.

0.4 The last few years in the history of development of high voltage switchgear, have seen considerable advancement in knowhow on the performance of the equipment and the associated stipulations that are to be precisely made in the national standards. Considerable modifications therefore, became necessary in the specifications on circuit-breakers, switches, fuses, etc, in order to keep pace with the international thinking on the subject.

*Specification for alternating current isolators (disconnectors) and earthing switches (first revision).

0.5 The present version of the standard on this subject is, therefore, being brought out to incorporate the latest in technology as is also recognized in international publications. For the purposes of clarity, this version is brought out in five parts as follows :

- Part I General and definitions,
- Part II Rating (under consideration),
- Part III Design and construction (under consideration),
- Part IV Type tests and routine tests (under consideration), and
- Part V Information to be given with tenders, enquiries and orders and rules for selection, transport, erection and maintenance (under consideration).

All parts shall be read in conjunction with one another. This standard (Part I) which deals with the general aspects and definition of terms partly replaces IS : 1818-1972*. All the parts in the series together will replace IS : 1818, completely.

0.6 While preparing this standard, assistance has been derived from IEC Pub : 129-1975 ' Alternating current disconnectors (isolators) and earthing switches ' published by the International Electrotechnical Commission.

0.7 In order to facilitate comparison with the international standards and for ease of reference, the Committee has decided to add in the form of an appendix, the major differences between this Indian Standard and the corresponding IEC publication (*see* Appendix A).

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This specification applies to alternating current disconnectors and earthing switches, designed for indoor and outdoor installation, for voltages above 1 000 V and for the service frequency of 50 Hz.

1.2 The specification also applies to the operating devices of these disconnectors and earthing switches and their auxiliary equipment.

*Specification for alternating current isolators (disconnectors) and earthing switches (*first revision*).

†Rules for rounding off numerical values (*revised*).

1.3 This specification does not deal with additional requirements for disconnectors and earthing switches in enclosed switchgear and controlgear, as these are covered by separate Indian Standards.

1.4 Disconnectors in which a fuse is an integral part are also not covered by this specification.

1.5 This specification (Part I) covers the general aspects and definitions applicable to disconnectors and earthing switches.

2. NORMAL SERVICE CONDITIONS

2.1 Disconnectors and earthing switches conforming to this standard are intended for use under the following normal service conditions.

a) Ambient air temperature

The reference ambient temperature is 40°C.

NOTE 1 — The reference ambient temperatures assumed for the purpose of this specification are :

- i) Maximum ambient air temperature : 45°C
- ii) Maximum daily average ambient air temperature : 35°C
- iii) Maximum yearly average ambient air temperature : 30°C, and
- iv) Minimum ambient air temperature : — 5°C.

NOTE 2 — The values of reference ambient temperatures assumed for the purposes of this standard are based on meteorological data in India collected over the past several years. For the information of the users of Indian Standards on the subject of electrotechnology, details of the data collected and the basis of the assumptions made and conclusions drawn are given in IS : 9676-1980*.

- b) The altitude does not exceed 1 000 m,
- c) The ambient air is not materially polluted by dust, smoke, corrosive or flammable gases and vapours, or salts,
- d) For outdoor disconnectors and earthing switches, the ice coating does not exceed 1 mm,
- e) For outdoor disconnectors and earthing switches, the wind pressure does not exceed 700 N/m² [see Fig. 1 of IS : 5613 (Part I / Sec 1)-1970† for wind pressure map of India],
- f) For indoor disconnectors and earthing switches, the humidity may attain high values, but condensation on the disconnector or earthing switch does not occur.

NOTE — Condensation can be expected where sudden temperature changes occur in periods of high humidity. Such condensation may be prevented through special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment.

*Reference ambient temperature for electrical equipment.

†Code of practice for design, installation and maintenance of overhead power lines; Part I Lines up to and including 11 kV, Section 1 Design.

- g) Earth tremors are not expected. (Guidance on seismic zones of India can be drawn from IS : 1893-1975*.)

NOTE — For disconnectors which are intended to carry a current approximately equal to their rated normal current for a long time without being opened, the manufacturer should be consulted.

3. ABNORMAL SERVICE CONDITIONS

3.1 This specification may, by special agreement between the manufacturer and the user, be applied to disconnectors and earthing switches to be used under conditions more severe than the normal service conditions given in 2. For such abnormal service conditions the following applies with reference to the corresponding items of 2:

- a) The manufacturer shall be consulted if a disconnector or earthing switch is to be located where the temperature may fall outside the limits stated in 2(a);
- b) The manufacturer shall be consulted if the altitude of the installation is above 1 000 m;
- c) For operation under conditions of substantial pollution (*see* Part IV of this standard);

NOTE — In coastal areas, salt pollution is often a problem even in indoor stations.

- d) For operation under severe ice conditions (*see* Part IV of this standard);
- e) The manufacturer shall be consulted if wind pressures exceeding 700 N/m² are foreseen.
- f) Abnormal humidity conditions representative of indoor installations, in which condensation may occur occasionally are the following:
 - i) the average value of the relative humidity, measured during any period of 24 h, can be 95 percent,
 - ii) the average value of the vapour pressure, for any period of 24 h, can be 22 mbar,
 - iii) the average value of the relative humidity, for any period of one month, can be 90 percent, and
 - iv) the average value of the vapour pressure, for any period of one month, can be 18 mbar.

To withstand the effects of high humidity and occasional condensation, such as breakdown of insulation or corrosion of metallic parts, indoor disconnectors and earthing switches designed for such conditions and tested accordingly or outdoor disconnectors and earthing switches may be used.

*Criteria for earthquake resistant design of structures (*third revision*).

- g) Agreement shall be reached between the manufacturer and the user in cases where earth tremors can be expected.

4. DEFINITIONS

4.0 For the purpose of this specification, the definitions given below shall apply.

4.1 Devices

4.1.1 *Disconnecter (Isolator)* — A mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements.

A disconnector is capable of opening and closing a circuit when either negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnector occurs. It is also capable of carrying currents under normal circuit conditions and carrying, for a specified time, currents under abnormal conditions such as those of short-circuit.

NOTE 1 — "Negligible current" implies currents such as the capacitance currents of bushings, busbars, connections with very short lengths of cables, currents of permanently connected grading impedances of circuit-breakers and currents of voltage transformers and dividers. For rated voltages of 420 kV and below, a current not exceeding 0.5 A is deemed to be a negligible current for the purpose of this definition; for rated voltages above 420 kV, the manufacturer shall be consulted.

NOTE 2 — "No significant change in voltage" refers to such applications as the bypassing of induction voltage regulators or circuit-breakers.

4.1.2 *Divided Support Disconnecter or Earthing Switch* — A disconnector or earthing switch whose fixed and moving contacts of each pole are not fixed on a common base or frame.

NOTE — A pantograph disconnector is an example.

4.1.3 *Earthing Switch* — A mechanical switching device for earthing parts of a circuit capable of withstanding for a specified time currents under abnormal conditions such as those of short-circuit, but not required to carry current under normal conditions of the circuit.

NOTE 1 — An earthing switch may have a rated short-circuit-making current.

NOTE 2 — Earthing switches may be combined with disconnectors.

4.1.4 *Indoor Disconnecter or Earthing Switch* — A disconnector or earthing switch designed solely for installation within a building or other housing where the disconnector or earthing switch is protected against wind, rain, snow, abnormal dirt deposits, abnormal condensation, ice and hoar-frost.

4.1.5 *Outdoor Disconnecter or Earthing Switch* — A disconnector or earthing switch suitable for installation in the open air that is capable of

withstanding wind, rain, snow, dirt deposits, condensation, ice and hoar-frost.

4.2 General Terms for Devices

4.2.1 Main Circuit — All the conducting parts of a disconnector or earthing switch included in the circuit which it is designed to close or open.

4.2.2 Control Circuit — All the conducting parts of a disconnector (other than the main circuit) used for the closing operation or opening operation, or both.

4.2.3 Auxiliary Circuit — All the conducting parts of a disconnector or earthing switch intended to be included in a circuit other than the main circuit and the control circuits.

NOTE — The same auxiliary circuits serve supplementary requirements such as signalling, interlocking, etc, and as such they may be connected to the control circuit of another switching device.

4.2.4 Pole — The portion of a disconnector or earthing switch associated exclusively with one electrically-separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together.

NOTE — A disconnector or earthing switch is called single-pole if it has only one pole. If it has more than one poles, it may be called multi-pole (two-pole, three-pole, etc) provided the poles are or can be coupled in such a manner as to operate together.

4.2.5 Closed Position — The position in which the predetermined continuity of the main circuit is secured.

4.2.6 Open Position — The position in which the predetermined clearance between open contacts in the main circuit is secured.

4.2.7 Position-Indicating Device — A device which indicates, at the location of the disconnector or earthing switch, whether the contacts of the main circuit are in the open or closed position.

4.2.8 Position-Signalling Device — A part of a disconnector or earthing switch which enables a signal to be given, generally at a location remote from the disconnector or earthing switch, indicating whether the contacts of the main circuit are in the open or closed position.

4.2.9 Interlocking Device — A device which makes the operation of a disconnector or earthing switch depend upon the position or operation of one or more other pieces of equipment.

4.2.10 Ambient Air Temperature — The temperature, determined under prescribed conditions, of the air surrounding the complete switching device (for example, for enclosed switching devices, it is the air outside the enclosure).

4.2.11 Temperature Rise (of a Part of a Disconnecter or Earthing Switch) — The difference between the temperature of the part and the ambient air temperature.

4.3 Constitutional Elements

4.3.1 Terminal — A conducting part of a disconnecter or earthing switch provided for electrical connection to external circuits.

4.3.2 Contact — Two or more conductors designed to establish circuit continuity when they touch, and which, due to their relative motion during operation, open or close a circuit.

NOTE — See Note to 4.3.3.

4.3.3 Contact Piece — One of the conductors forming a contact.

NOTE — If no misunderstanding can arise, the term 'contact' may be used instead of 'contact piece'.

4.3.4 Main Contact — A contact included in the main circuit of a disconnecter or earthing switch intended to carry the current of the main circuit in the closed position.

4.3.5 Control Contact — A contact included in a control circuit of a disconnecter or earthing switch and mechanically operated by the disconnecter or earthing switch.

4.3.6 Auxiliary Contact — A contact included in an auxiliary circuit and mechanically operated by the disconnecter or earthing switch.

4.3.7 Make Contact; a-Contact — A control or auxiliary contact which is closed when the main contacts of the disconnecter or earthing switch are closed and open when they are open.

4.3.8 Break Contact; b-Contact — A control or auxiliary contact which is open when the main contacts of the disconnecter or earthing switch are closed and closed when they are open.

4.3.9 Contact Zone (for Divided Support Disconnectors and Earthing Switching) — The spatial region delimiting the various positions the fixed contact may take up for correct engagement with the moving contact.

4.4 Operation

4.4.1 Operation — The transfer of the moving contact(s) from one position to an adjacent position.

NOTE 1 — This may be either a closing operation or an opening operation.

NOTE 2 — If distinction is necessary, an operation in the electrical sense, for example, make or break, is referred to as a 'switching operation' and an operation in the mechanical sense, for example, close or open, is referred to as a 'mechanical operation'.

4.4.2 Closing Operation — An operation by which the disconnector or earthing switch is brought from the open position to the closed position.

4.4.3 Opening Operation — An operation by which the disconnector or earthing switch is brought from the closed position to the open position.

4.4.4 Operating Cycle — A succession of operations from one position to another and back to the first position through all other positions, if any.

NOTE — A succession of operations not forming an operating cycle is referred to as an 'operating series'.

4.4.5 Dependent Manual Operation — An operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator.

4.4.6 Dependent Power Operation — An operation by means of energy other than manual, where the completion of the operation is dependent upon the continuity of the power supply (to solenoids, electric or pneumatic motors, etc).

4.4.7 Stored Energy Operation — An operation by means of energy stored in the mechanism itself prior to the operation and sufficient to complete it under predetermined conditions.

NOTE — This kind of operation may be subdivided according to :

- a) the manner of storing the energy (spring, weight, etc);
- b) the origin of the energy (manual, electric, etc); and
- c) the manner of releasing the energy (manual, electric, etc).

4.4.8 Independent Manual Operation — An operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator.

4.5 Characteristic Quantities

4.5.1 Rated Value — A stated value of any one of the characteristic values that serve to define the working conditions for which the disconnector or earthing switch is designed and built.

NOTE — See Part II for individual rated values.

4.5.2 Prospective Current (of a Circuit and With Respect to a Disconnector or to an Earthing Switch) — The current that would flow in the circuit if each pole of the disconnector or earthing switch were replaced by a conductor of negligible impedance.

4.5.3 Prospective Peak Current — The peak value of the first major loop of the prospective current during the transient period following initiation.

NOTE — The definition assumes that the current is made by an ideal switching device, that is, with instantaneous and simultaneous transition of its impedance across the terminals of each pole from infinity to zero. The peak value may differ from one pole to another; it depends on the instant of current initiation relative to the voltage wave across the terminals of each pole.

4.5.4 Maximum Prospective Peak Current — The prospective peak current when the initiation of current takes place at the instant which leads to the highest possible value.

NOTE — For a polyphase circuit, the maximum prospective peak current occurs in one phase only.

4.5.5 (Peak) Making Current (of an Earthing Switch) — The peak value of the first major loop of the current in a pole of the earthing switch during the transient period following the initiation of current during a making operation.

NOTE 1 — The peak value may differ from one pole to another and from one operation to another, as it depends on the instant of current initiation relative to the wave of the applied voltage.

NOTE 2 — Where, for a polyphase circuit, a single value of (peak) making current is referred to, this is, unless otherwise stated, the highest value in any phase.

4.5.6 Peak Current — The peak value of the first major loop of current during the transient period following initiation.

4.5.7 Normal Current (of a disconnector) — The current which the main circuit of the disconnector is capable of carrying continuously under specified conditions of use and behaviour.

4.5.8 Short-time Withstand Current — The current that a disconnector or earthing switch can carry in the closed position during a specified short time under prescribed conditions of use and behaviour.

4.5.9 Permissible Duration of Short-Circuit Current — The time during which a disconnector or earthing switch in the closed position can carry a short-circuit current of specified value.

4.5.10 Permissible Peak Withstand Current — The value of peak current that a disconnector or earthing switch can withstand in the closed position under prescribed conditions of use and behaviour.

4.5.11 Rated Insulation Level

- a) For disconnectors and earthing switches with highest voltage for equipment equal to or greater than 300 kV : the rated switching and lightning impulse withstand voltages.
- b) For disconnectors and earthing switches with highest voltage for equipment lower than 300 kV: the rated 1 min power-frequency and lightning impulse withstand voltages.

4.5.12 Rated 1 min Power Frequency Withstand Voltage — The rms value of the sinusoidal alternating voltage at power-frequency which the insulation of the disconnecter or earthing switch withstands under specified test conditions.

4.5.13 Rated Impulse Withstand Voltage — The peak value of the standard impulse voltage wave which the insulation of the disconnecter or earthing switch withstands under specified test conditions.

NOTE — Depending on the shape of the wave, the term may be qualified as switching impulse withstand voltage or lightning impulse withstand voltage.

4.5.14 External Insulation — The distances in atmosphere and the surfaces in contact with open air of solid insulation of the equipment which are subject to dielectric stresses and to the effect of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

4.5.15 Internal Insulation — The internal solid, liquid or gaseous parts of the insulation of the equipment which are protected from the effects of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

4.5.16 Self-Restoring Insulation — Insulation which completely recovers its insulating properties after a disruptive discharge caused by the application of a test voltage.

4.5.17 Non-Self-Restoring Insulation — An insulation which loses its insulating properties or does not recover them completely after a disruptive discharge caused by the application of a test voltage; insulation of this kind is generally (but not necessarily) internal insulation.

4.5.18 Disruptive Discharge — The term 'disruptive discharge' relates to phenomena associated with the failure of insulation under electrical stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly to zero. It applies to electrical breakdown in solid, liquid and gaseous dielectrics and to combinations of these.

A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength; in a liquid or gaseous dielectric, the loss may be only temporary.

4.5.19 Clearance — The distance between two conducting parts along a string stretched the shortest way between these conducting parts.

4.5.19.1 Clearance between poles — The clearance between any conducting parts of adjacent poles.

4.5.19.2 Clearance to earth — The clearance between any conducting parts and any parts which are earthed or intended to be earthed.

4.5.19.3 Clearance between open contacts (gap) — The total clearance between the contacts, or any conducting parts connected thereto, of a pole of a disconnector or earthing switch in the open position.

NOTE — When determining the total clearance, the sum of the distances shall be taken into consideration.

4.5.20 Isolating Distance — The clearance between open contacts or any conducting parts connected thereto in a pole of a disconnector meeting safety requirements.

4.5.21 Mechanical Terminal Loads — The external mechanical load at each terminal equivalent to the combined mechanical forces to which the disconnector or earthing switch may be subjected, not including wind forces acting on the equipment itself.

NOTE 1 — A disconnector or earthing switch may be subjected to several mechanical forces different in value, direction and point of action.

NOTE 2 — Mechanical terminal loads do not include electromagnetic forces of short-circuit currents.

APPENDIX A

(Clause 0.7)

COMPARISON WITH CORRESPONDING IEC PUBLICATION

A-0. This standard corresponds appreciably with the IEC publication referred to in 0.6, except for the following changes.

A-1. Clause 2.1 (a) — The reference ambient air temperature conditions of temperature specified in IEC publication have been modified to represent Indian conditions, to align with other Indian Standards on the subject.

Clause 2.1 (e) and (g) — For additional guidance on wind pressure and seismic forces and the applicable zones for India, suitable references have been made to relevant Indian Standards on the subject. Special agreement called for between the manufacturer and the user in deciding the application severity of equipment shall take recourse to the data available in them.

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 331 01 31, 331 13 75

Telegrams: Manaksanstha
(Common to all Offices)

Regional Offices:

	Telephone
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